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STUDY OF THE ECONOMIC IMPACT OF SULFUR REGULATIONS
PROMULGATED BY THE U.S. ENVIRONMENTAL PROTECTION
AGENCY FOR OHIO ON AUGUST 27, 1976

STUDY DOCUMENT NUMBER 1. INFLATIONARY IMPACT
STATEMENT ON SULFUR OXIDE REGULATIONS FOR OHIO

ENERGY AND ENVIRONMENTAL ANALYSIS, INCORPORATED,
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FOR OHIO

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of Sulfur Regulations Promulgated by
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for Ohio on August 27, 1976]

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DOCUMENTATION

This summary report is backed up by a series of nine support documents which provide details on data utilized, methodology and study findings. Appendix A contains a description of the support documentation.

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SECTION I

DESCRIPTION OF ACTION AND ALTERNATIVES CONSIDERED

This report constitutes an Inflationary Impact Statement^{1/} on sulfur oxide regulations prepared by the U.S. Environmental Protection Agency to correct deficiencies in the Ohio State Implementation Plan.

On November 10, 1975, EPA proposed substitute regulations for review and public comment (40FR52410). On August 27, 1976 EPA promulgated final regulations regarding sulfur oxides (41FR36323). This IIS was prepared on the final version of the regulations.

The evaluation of the economic impact of the final version of the regulations has been compared to impacts under the proposed (November, 1975) regulations. This comparison reflects the cost savings and reduction of economic impact achieved in the final regulations as a consequence of EPA efforts including: an updated refined emission inventory and more refined air quality modeling techniques, development of generic, flexible regulations for large isolated emission sources (allowing certain power plants to adopt cost-effective control strategies within specified limits) plus a refined approach to regulation development on a source specific basis to account for air quality contribution and cost minimization.

The impacts of the final regulation can also be viewed as a comparison to the status quo since all cost and economic impacts are shown in relation to the 1973 and 1974 fuel use and compliance status.

1/ Required under Executive Order 11821, OMB Circular A-107 and EPA guidelines.

It should be emphasized that except as noted all economic impacts shown in this report are overstated in that they take no account of costs that must be incurred to comply with county or city ordinances which would be in effect in the absence of this U.S. EPA action.

SECTION II
EXECUTIVE SUMMARY

A. Costs

Table II-1 summarizes the estimated cost impacts under the proposed and final regulations. The final regulations are expected to result in an incremental capital cost of \$594 million which would be spread over 1976-1979 if compliance is to be achieved by 1980. The annual capital and operating costs under the final regulation are estimated at \$171 million. The final regulations represent a significant cost reduction compared to the proposed regulations. Capital costs are \$950 million lower and annual costs over \$230 million lower under the final regulations.

B. Impacts on the Electric Utility Sector

1. Consumer Prices

The proposed regulations would result in an estimated average increase in the price of electricity of 7.9 percent in 1980. This would result in an increase in the average residential customer's monthly bill of \$2.40. The projected price impacts of the final regulation are substantially less, resulting in an average increase in consumer charges of 2.9 percent and an increase of \$.88 in the average monthly residential bill in 1980.

2. Financial Impacts

The capital expenditures required during the period 1976-79 in order to comply with the proposed regulations would increase by an average of 29 percent over the baseline capital expenditures which would be required in the absence of the regulations. Capital expenditures under the final regulations are anticipated to increase by an average of 10.7 percent.

Of the eight major investor-owned utilities in Ohio, five could reasonably be expected to have little or no difficulty

TABLE II-1
CAPITAL AND ANNUAL COST IMPACTS OF THE
PROPOSED AND FINAL REGULATIONS
(millions of 1975 dollars)

<u>Sector</u>	<u>Proposed Regulation</u>	
	<u>Capital^{1/}</u>	<u>Annual</u>
Electric Utility	1480	354
Industrial	<u>67</u>	<u>50</u>
Total	1547	404

<u>Sector</u>	<u>Final Regulation</u>	
	<u>Capital^{1/}</u>	<u>Annual</u>
Electric Utility	542	130
Industrial	<u>52</u>	<u>41</u>
Total	594	171

<u>Sector</u>	<u>Savings of Final Regulation</u>	
	<u>Capital^{1/}</u>	<u>Annual</u>
Electric Utility	938	224
Industrial	<u>15</u>	<u>9</u>
Total	953	233

1/ Expenditures over the 1976-79 period.

in obtaining financing for the equipment required by the final regulations. Two of the utilities, Ohio Power and Ohio Edison, may have some difficulty obtaining debt financing but should be in a position to issue additional common stock to cover the cost, if necessary. One utility, Ohio Valley Electric, would not be affected by the final regulations.

C. Industrial Sector Impacts

1. Distribution of Impacts

The estimated costs of compliance are concentrated in a few heavy industries: petroleum refining, chemicals and primary metals. Costs incurred by these sectors plus impacts on institutions such as military bases account for over 80 percent of the estimated impacts. The costs are largely incurred by plants located in the urban counties of Ohio.

2. Economic and Financial Impacts

The only significant price impacts are anticipated in the sulfuric acid industry and for a few institutions, primarily military installations. In spite of an average expected price increase of 10 percent for 4 sulfuric acid plants, no significant economic impacts are anticipated. This conclusion is supported by analyses which show that high transportation costs tend to insulate Ohio plants from competition, that plants in nearby states are subject to roughly similar sulfur emission regulations and the fact that most of the plants in Ohio have initiated installation of pollution abatement systems to comply with an existing state regulation. One plant is alleged to be closing as a consequence of litigation under the state sulfur emission regulations.

Aside from the sulfuric acid plants, the only other significant impacts are financial burdens on two steel making firms. The incremental capital costs under the final regulations are estimated to add roughly 1 percent to their corporate investments. The firms already anticipate significant capital outlays due to

expansion plans and other pollution control requirements. However, these corporations are large, integrated companies with currently sound financial structures so that the extra capital requirements should be viewed as small additions to their financial burdens.

On further examination of plant-specific characteristics, one old oil refinery is expected to incur substantial capital costs. The plant may be phased out earlier than scheduled as a consequence of the regulations.

D. Energy Impacts

1. Proposed Regulations

There is a significant shift in demand from high to medium sulfur coal under the proposed regulations. The effects on the sources of coal supplied to Ohio are shown in Table II-2. High sulfur coal production from Indiana, W. Kentucky, northern West Virginia and Pennsylvania is estimated to decline by 4.2 million tons. Production destined for use in Ohio utility and industrial plants increases in Central Appalachia and the western states. Extensive coal washing could lead to a substantial increase in Ohio production. Overall demand for coal Btu's by Ohio plants increases by over 3.3 percent as a consequence of energy penalties resulting from flue gas desulfurization systems and upgraded particulate control equipment.

2. Final Regulations

Coal production patterns under the final regulations reflect few differences from the existing situation. While consumption of Ohio coal declines by 900,000 tons, other high sulfur coal demand declines by 1.7 million tons. These declines are offset by greater imports of low sulfur coal into Ohio. The energy penalty under the final regulations declines to 1.3 percent above the existing coal energy consumption. Fuel switching from coal to oil is negligible under both the proposed and final regulations.

TABLE II-2

COAL CONSUMPTION IN OHIO BY EXISTING FACILITIES
(10⁶ Tons)

<u>Region</u>	<u>Existing</u>	<u>Proposed Regulation</u>	<u>Final Regulation</u>
Ohio	35.8	37.2	34.9
Northern Appalachia	8.3	4.5	6.7
Central Appalachia	11.7	14.4	13.2
Western ^{1/}	1.6	4.1	3.7
Other ^{2/}	<u>2.2</u>	<u>1.8</u>	<u>2.2</u>
Total	59.6	62.0	60.8 ^{3/}

^{1/} Colorado, Montana, Utah, Wyoming

^{2/} Indiana, Western Kentucky

^{3/} Does not total due to rounding.

SECTION III

REGULATIONS

A. Proposed Regulations

The proposed regulations for fossil fuel-fired steam generators (boilers) specified county-wide emission standards. Twelve, primarily urban counties received sliding scale regulations which have the form

$$E = aQ^{-b}$$

where E = emission limit in pounds of SO₂ per million Btu, Q = total rated capacity of heat input connected to the stack, and a and b are specified constants. Emission limits under a typical sliding scale regulation would range from 5 pounds for sources with rated capacity less than 25 million Btu per hour down to 1.4 pounds for those with capacity over 2,000 million. In another forty-two counties, the regulations applied were specifically stated in pounds of SO₂ per million Btu's. Such so-called "flat" regulations make no distinctions among sources since all are controlled to the same emission level. The remaining thirty-four counties were left unregulated since sulfur dioxide emitting sources either did not exist or were expected to have an insignificant effect on ambient air quality in these counties.

General industrial processes were given emission limitations for 55 counties under the proposed regulations. That regulation was

$$E = 19.5 (P)^{0.67}$$

where E = emissions and P = process weight rate in tons/hr. Apart from those general processes there were the following

specific industrial process regulations: (1) chemical processes, 6.5 pounds of SO₂ per ton of acid produced, (2) fuel-gas burning processes, 50 grains H₂S/100 dscf, for the same 55 counties. 33 counties received no industrial process regulations.

B. Final Regulations

The fossil fuel fired boilers are regulated under either flat county-wide limitations or source specific regulations. In 17 cases only a county regulation applied. In 15 other counties a flat regulation is supplemented by source specific emission limitations. 18 counties were given only source-specific regulations with the remaining sources in those counties judged to be insignificant contributors to the area air quality problem.

General industrial processes are now regulated by county-specific or source-specific limitations in pounds of SO₂/ton of process weight rate. Industrial processes in 63 counties have been left unregulated.

C. Comparison

The proposed regulations were set on the basis of information on one or more sources within the county. The final regulations reflect a more comprehensive study of sources and their locations. They include no regulations which have state-wide application and supplement or replace county regulations with 137 source specific emission limitations, 97 applying to industrial establishments and 40 to utilities. This response to public comment on county and state-wide regulations represents a major change in the nature of the emissions limitations. The kinds of regulations imposed under each set of regulations are shown in Table III-1. In general, it may be noted that the final regulations are tighter than the proposed regulations for industry in urban areas and more lenient for many rural areas. Likewise, process

regulations are, in general, less stringent while steam generation regulations have become more stringent. The final regulations are much less restrictive for utilities and there is a flexible form of regulation which allows utilities to select the lowest cost control strategy within specified limits.

TABLE III-1

SUMMARY OF REGULATIONS

NUMBER OF COUNTIES BY TYPE OF REGULATION

	Proposed Regulations	Final 1/ Regulations
Steam Generation Regulations ^{2/}		
flat	42	27
sliding scale	12	6
source specific	2	36
no regulation	34	36
General Process Regulations ^{3/}		
flat	0	20
sliding scale	55	3
source specific	0	8
no regulation	33	63
Other Process Regulations ^{3/}		
flat	55	9
source specific	0	5
no regulation	33	76

- 1/ Under final regulations many counties have more than one type of regulation for the same type of installation. Therefore, sum of counties will be more than the total number of counties in Ohio (88).
- 2/ These establishments burn fossil fuel for the purpose of generating steam.
- 3/ These establishments burn either fossil fuel or fuel gas (hydrogen sulfide) to provide direct process heat.

SECTION IV

METHODOLOGICAL APPROACH

A. Level of Analysis

The final output of the study focuses on price, output, employment, energy and financial impacts of the proposed and final sulfur oxide regulations. An early decision was to analyze impacts at the plant level in both the utility and industrial sectors. In the utility sector this was necessary in order to provide credible cost of control estimates since such estimates are a function of plant and stack specific parameters such as fuel consumption or capacity. In addition, since impacts were to be developed separately for major utility systems in Ohio, estimates of capital and operating costs at the plant level were essential.

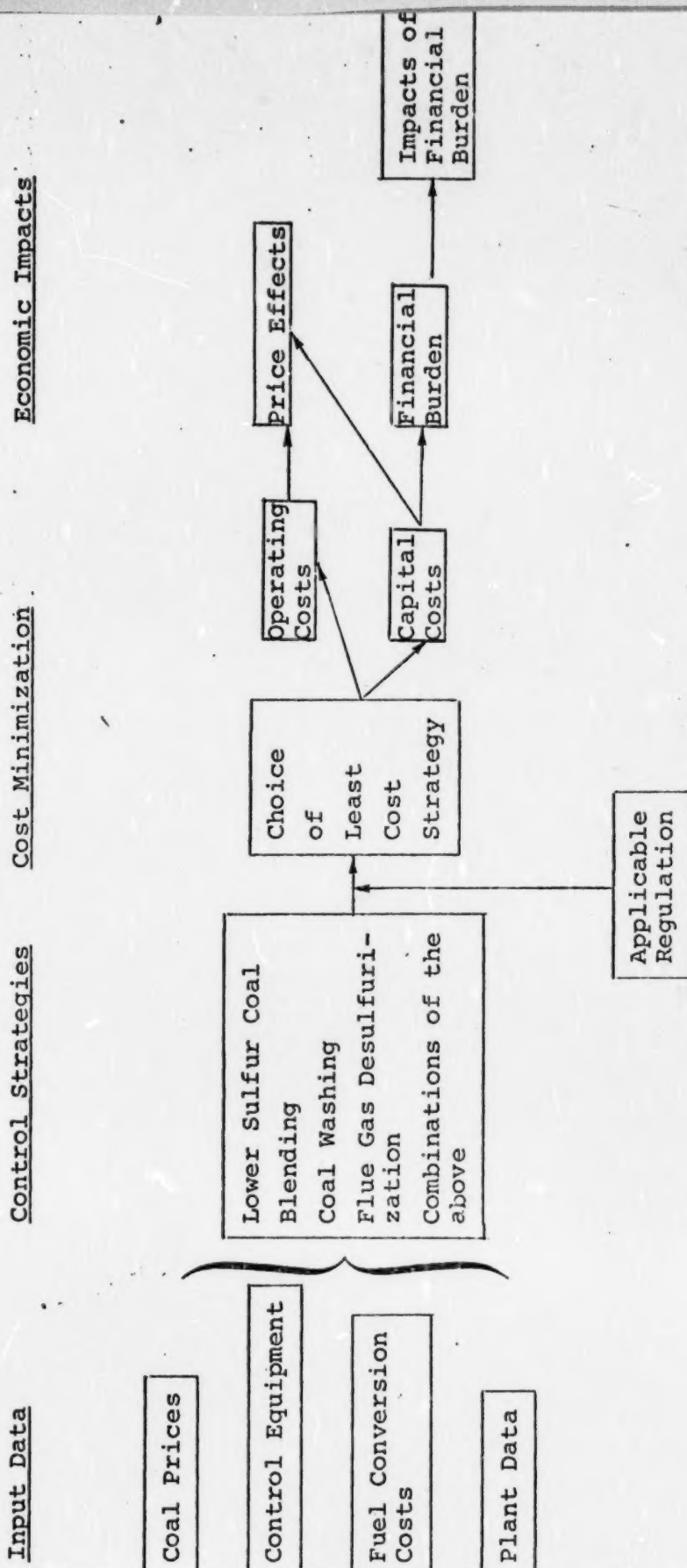
Analyses were conducted at the plant level because for the industrial sector average impacts were expected at the outset to be negligible. Using price impacts as an illustration, of 20 plants in a given industry, only 10 might be out of compliance (thereby incurring some costs) and perhaps only 4 might incur significant price effects, e.g., 5-10 percent. A sales weighted average for all plants in the industry would show a price effect of less than 1 percent, leading to a potentially misleading conclusion of no significant impacts. For this reason it was essential to derive the distribution of impacts among affected plants rather than to rely on estimates of average impacts.

B. Analytical Elements

Figure 4-1 is a schematic diagram of the analytical elements

Figure 4-1

Methodology - Utilities



used to derive economic impacts for the electric utility industry.

1. Basic Data

Data were collected for the purpose of estimating costs separately for each power plant stack. These data elements included:

- stack and plant specific parameters which could affect costs (e.g., megawatt capacity, capacity utilization, age)
- estimates of the delivered costs of coal of various sulfur contents to each plant
- costs of converting from one type of coal to another (e.g., boiler modifications, derates)
- costs of pollution control equipment for flue gas desulfurization systems and particulate control equipment^{1/}

These inputs were used to derive capital and operating costs for various alternative means of meeting specified sulfur oxide emission limits.

2. Alternative Control Strategies

The above inputs were combined to generate costs for several alternative means of complying with applicable regulations:

- switching to a lower sulfur coal
- blending new supplies of low sulfur coal with existing coal
- coal washing at the power plant or near the coal mine
- installation of flue gas desulfurization (FGD) equipment
- combinations of the above strategies

^{1/} Particulate control must be upgraded if the plant switches to a lower sulfur coal.

Some of the factors considered in developing the cost of these systems include: fuel cost differentials by sulfur content, costs of upgrading particulate control, power penalties for FGD and particulate control equipment, costs of blending facilities, boiler or pulverizer derates due to fuel switching, costs of replacement capacity and added steam demands to operate FGD units.

Since the precise form and levels of the final sulfur oxide regulations were unknown at the start of the study, cost curves (annual and capital costs as a function of various sulfur emission rates) were developed for each control strategy. These curves were developed for each stack since emission regulations could vary among stacks at the same plant.

3. Utility Cost Minimization

For each power plant, costs were then determined for a specified emission limit or set of stack specific emission rates. This cost minimization step was keyed to the criteria approximating minimization of the discounted (over 20 years) annual cost of complying with the regulation.^{1/} This algorithm selected the least cost strategy (e.g., FGD) as well as the level of sulfur removal required to achieve the regulation. This choice of control strategy provided not only annual and capital costs but outputs including relevant energy penalties and shifts in the sources of coal supply among producing regions.

4. Utility Economic Impacts

The costs calculated above were then converted to meaningful indicators of economic impact. This was accomplished by the generation of a baseline forecast of consumer charges and capital requirements for each utility system. Costs were then aggregated for the plants owned by each utility system, accounting for joint

1/ Annual costs include all operating costs plus the annualized cost of capital, and a rate of return on equity.

ownership of facilities, to show the incremental increase in consumer charges for electricity and the percentage increase in capital requirements estimated for compliance with the sulfur oxide regulations. An evaluation was then made of each utility system's ability to finance these added investments in terms of factors such as internal versus external sources of funds and resultant changes in financial viability parameters such as debt equity or interest coverage ratios.

5. Non-utility Sectors

A similar methodology was applied to the industrial sector. Costs for industrial boilers were calculated using the same logic as Figure 2-1 while cost curves for industrial processes (refineries, coke ovens, sulfuric acid plants, etc.) were generated using the most likely control technologies.

The product of this sector study addresses the impacts of regulations on product prices for manufacturing firms and subsequent production and employment impacts. Financial burdens are also assessed and potential plant shut-downs are identified. For institutions such as hospitals, the analysis is confined to presenting the estimated impact of fuel cost increases on operating budgets.

The potential price impacts of these cost increases are evaluated at the plant level in a series of screening steps of increasing sophistication. This evaluation process combines plant specific data (such as energy consumption or annual production) with state or national parameters to develop approximate estimates of the value of sales at the plant level. The estimated costs of compliance with sulfur oxide regulations are then compared to sales to estimate price impacts. For those industry sub-groups where significant price increases are anticipated, a followup analysis is conducted to evaluate potential output and employment effects. This analysis includes such factors as:

potential competition from neighboring states, relative severity of the Ohio regulations, the number of employees that might be affected, the nature of the product market, general trends in the affected industry and plans already underway to install pollution control equipment as a consequence of state or local regulations.

Capital requirements for pollution control devices at the plant level are aggregated to corporate level in order to evaluate a firm's ability to finance the estimated investment requirements. These incremental capital expenditures are compared for significance with normal annual business investment expenditures. Where pollution control investments constitute a significant increase in overall capital requirements, the firm's capability to finance the additional expenditures is discussed. Older, economically marginal plants are identified where firms may elect to speed up phaseout schedules rather than incur the capital expenditures necessary to comply with applicable regulations.

6. Energy Impacts

The study also discusses the energy implications of the probable control strategies selected by utility and industrial plants to comply with the sulfur oxide regulations. The shift in coal production patterns under the proposed and final regulations for both utilities and industry is analyzed. The impact on coal production includes the effect of such factors as energy penalties due to environmental control equipment, energy lost in the coal washing process, capacity derates when western coal is the control strategy choice, the shift in coal demand by sulfur content and the potential for coal-to-oil switching in the industrial sector. The report focuses on the expected change in coal production destined for Ohio markets, especially impacts on areas, such as Ohio, producing higher sulfur content coal.

SECTION V

ANTICIPATED IMPACTS ON THE OHIO ELECTRIC UTILITY INDUSTRY

A. Introduction

There are presently 33 major electric power plants in Ohio operated by 8 investor-owned utility systems and 13 municipal and cooperative utilities. Together they account for a coal-fired capacity of over 23,000 megawatts and burn approximately 52 millions tons of coal annually. The investor-owned utilities account for approximately 94 percent of this capacity and over 96 percent of the electricity generation in Ohio. For this reason the analysis focuses on the impacts of these investor-owned systems.

This section summarizes the number of plants affected and their probable compliance strategies, the resulting increase in capital expenditures and annual revenue requirements, and the impact on the consumer price of electricity under both the proposed and final regulations. It also summarizes the ability of the Ohio investor-owned utilities to finance the required sulfur dioxide removal and the changes which are predicted in the utilities' coal consumption pattern. Finally, the energy implications of the probable mix of control strategies selected are presented.

B. Control Strategies Selected and Aggregate Cost Impacts

The economic and energy impacts of the proposed and final regulations are primarily determined by the stringency of the regulations and the subsequent emission control strategy selected by the utilities to achieve compliance. In this analysis, early retirement was not considered as a compliance strategy.

1. Control Strategies

a. Proposed Regulation

Under the proposed regulation, essentially all of the coal-

fired capacity in Ohio would be out of compliance. Table V-1 shows the mix of control strategies selected by the plants. The anticipated choices reflect a roughly equal balance of FGD and low sulfur coal. The stringency of the proposed regulations is reflected by the estimate that 14 percent of utility capacity would have to both switch coal supplies and install FGD to comply with the regulations, primarily because FGD alone will not obtain sufficient sulfur removal to attain the applicable regulation. In addition, 39 percent of capacity would have to install FGD on current coal.

b. Final Regulation

Under the final regulation, only 19 plants accounting for slightly over one-half of rated capacity are completely or partially out of compliance. Thus, the more flexible form and lesser stringency of the final regulations would bring half of Ohio utility capacity into compliance. The mix of control strategies in Table V-1 reflects the lesser stringency of the regulations since only a small percentage of capacity requires both FGD and low sulfur coal to satisfy applicable emission limits.

2. Aggregate Cost Impacts

Compliance with the proposed or final regulations will require the utilities to increase capital expenditures and annual revenues. The increase in capital expenditures will be required for installation of pollution control equipment (scrubbers, blending facilities, precipitators, etc.) and for replacement of existing generating capacity which is derated as a result of the use of low sulfur coal or control equipment. The total annual cost, or annual revenue requirements, of the utilities would increase due to increased operating and maintenance costs, fuel premiums, interest and depreciation charges on capital, and income and property taxes.

The capital costs and annual increases in consumer charges shown in Table V-2 reflect the significant cost reductions brought about by refinements of the final regulations compared to the proposed regulations. Especially significant is the reduction in

TABLE V-1

ANTICIPATED CONTROL STRATEGY SELECTION BY
MAJOR COAL FIRED POWER PLANTS
OF INVESTOR-OWNED UTILITIES

<u>Control Strategy</u> ^{1/}	<u>Proposed Regulations</u>			<u>Final Regulations</u>		
	<u>Plants</u>	<u>Mw</u> ^{2/}	<u>%</u>	<u>Plants</u>	<u>Mw</u> ^{2/}	<u>%</u>
Flue Gas Desulfurization	9	8,300	39	8	5,000	23
Low Sulfur Coal or Blending	11	9,100	42	10	6,100	29
FGD Plus Lower Sulfur Coal	4	3,100	14	1	300	1
Sub-Total	24	20,500	95	19	11,400	53
In Compliance	3	1,000	5	8	10,100 ^{3/}	47
Total	27	21,500	100	27	21,500	100

- 1/ Where FGD is selected, the megawatt capacity reflects those units requiring some use of FGD. The actual megawatts of scrubbing equipment required depends upon the degree of emission reduction required and will be less than the rated megawatt capacity.
- 2/ An estimate of the coal consumption in each of the compliance categories may be obtained using the assumption that each 1,000 Mw approximately consumes 2.5 million tons per year.
- 3/ Mw figure includes capacity of units in compliance at plant which have other units out of compliance.

Table V-2

ELECTRIC UTILITIES
COSTS OF SULFUR OXIDE REGULATIONS^{1/}

(Millions of 1975 Dollars)

<u>Alternatives</u>	<u>Total Increase in Capital Costs (1976-1979)</u>	<u>Required Increase in Annual Revenues in 1980</u>
Proposed	1480	354
Final	<u>542</u>	<u>130</u>
<u>Cost Reduction</u>	<u>938</u>	<u>224</u>

1/ The above costs include only investor-owned utilities. Costs for municipal systems were estimated at \$24 million of capital expenditures and a \$3 million annual cost increase.

capital requirements of two-thirds or nearly \$1 billion as a consequence of revisions incorporated into the final regulations.^{1/}

C. Consumer Price Impacts

1. Proposed Regulations

The proposed regulations would result in an estimated increase in consumer charges of 7.9 percent in 1980 declining to 4.9 percent by 1985. In 1980, this would result in an increase in the average residential customer's monthly bill of \$2.40. As shown in Table V-3, the price impacts differ substantially among the major investor-owned utilities, ranging from less than 1 percent to over 11 percent.

2. Final Regulations

Projected price impacts of the final regulations are substantially less; 2.9 percent in 1980 and 1.8 percent in 1985. The monthly residential bill would rise by \$.88 in 1980. Again the impacts vary considerably among utility systems, from zero to 6.6 percent for Cleveland Electric Illuminating.

D. Financial Impacts

1. Proposed Regulations

Capital expenditures required by 1980 to comply with the proposed regulations would result in an average increase of 29 percent above baseline requirements. External financing would increase at a somewhat more rapid rate. Individual utility systems could, however, experience up to an 86 percent increase in investment demand requirements (see Table V-4).

2. Final Regulations

Capital requirements would increase much less than under the proposed regulations but are anticipated to raise overall capital

^{1/} To the extent that some boilers may be retired as a consequence of the regulations, there costs would be overstated.

TABLE V-3
PROJECTED INCREASE IN CONSUMER CHARGES
FOR ELECTRICITY DUE TO SULFUR OXIDE REGULATIONS
(% increase in 1980)

	<u>Baseline</u>	<u>Proposed</u> <u>Regulation</u>	<u>Final</u> <u>Regulation</u>
	<u>mills/kwhr</u>	<u>% increase</u>	<u>% increase</u>
Cincinnati Gas and Electric	31.0	11.2	3.1
Cleveland Electric Illuminating	33.1	11.3	6.6
Columbus and Southern Ohio Electric	38.7	3.3	2.5
Dayton Power and Light	35.6	4.0	1.2
Ohio Edison	36.7	10.5	2.2
Ohio Power	20.4	7.2	1.5
Ohio Valley Electric	11.5	0.9	0.0
Toledo Edison	35.3	6.7	5.7
Average	27.5	7.9	2.9

TABLE V-4

PROJECTED INCREASES IN CAPITAL REQUIREMENTS
TO COMPLY WITH SULFUR OXIDE REGULATIONS

% Increase Above 1976-1979
Baseline

<u>Company</u>	<u>Baseline</u> (Millions of \$ 1975)	<u>Proposed</u> <u>Regulations</u>		<u>Final</u> <u>Regulations</u>	
		<u>Capital</u> <u>Expenditures</u>	<u>External</u> <u>Financing</u>	<u>Capital</u> <u>Expenditures</u>	<u>External</u> <u>Financing</u>
Cincinnati Gas and Electric	657	35.1	44.6	11.0	14.1
Cleveland Electric and Illuminating	879	35.9	42.4	23.0	27.4
Columbus and Southern Ohio Electric	535	6.2	7.5	7.2	8.8
Dayton Power and Light	572	10.8	13.0	3.7	4.4
Ohio Edison	1234	29.5	36.4	5.8	7.2
Ohio Power	448	86.0	79.7	15.2	13.5
Ohio Valley Electric	169	5.6	5.9	0.0	0.0
Toledo Edison	<u>587</u>	<u>13.5</u>	<u>15.2</u>	<u>11.6</u>	<u>13.4</u>
All Investor-Owned Utilities	5081	29.1	34.2	10.7	12.6

needs for investor-owned utilities by an average of 10.7 percent, ranging from 0 to 23 percent among affected companies. Once again external financing requirements might have to increase at a slightly more rapid rate to meet expected investment demands.

To determine the ability of Ohio investor-owned utilities to finance the SO₂ removal equipment required by the final regulations, each utility's capacity for issuing additional long-term debt and common equity was examined. While a utility's ability to raise capital is dependent on many factors, this analysis focused on two of the more important factors: debt coverage ratios and market-to-book stock price ratios. These two ratios, while somewhat limited, provide the best direct indications of a financing strength.

Although the final SO₂ regulations would increase the capital expenditures and external financing requirements of seven of the eight investor-owned utilities studied (Ohio Valley Electric would not be affected), five of the seven should experience little or no difficulty in raising the capital required. Those five are:

- Cincinnati Gas and Electric (CGE)
- Cleveland Electric Illuminating (CEI)
- Columbus and Southern Ohio (CSO)
- Dayton Power and Light (DPL)
- Toledo Edison (TEC)

These companies are now, and are projected to be, in a financial position which should enable them to finance the required SO₂ equipment by issuing additional long-term debt and/or common equity..

The debt coverage ratios are anticipated to be only marginally affected (the maximum impact is less than 7 percent) by

the final control regulations and are projected to remain above the 2.0 level specified in the Indenture Agreements for their outstanding bonds. In addition, each of the company's stock is currently selling slightly higher than the last reported book value (December 31, 1975). If this favorable market-to-book value position does not decrease, financing part of the expenditures with equity would also seem feasible.

Two of the Ohio utilities, Ohio Edison and Ohio Power, might have difficulty in financing the SO₂-related capital expenditures. Both companies have coverage ratios near 2.0 and are not projected to improve this ratio substantially by 1979.

While Ohio Edison's ability to raise additional debt financing may be limited, the amount required for SO₂ equipment, \$65.5 million, is small in comparison to its other financing needs for 1976-1979 of \$915.8 million. If it is not possible to obtain sufficient additional debt financing for the SO₂ equipment, a major portion of the financing appears possible with common equity. Ohio Edison's common stock is currently selling well above its 1975 book value of \$15.39. Assuming the market price of \$18.13 (August 26, 1976) holds, equity financing would appear to be feasible. Additional common equity on the order to \$65.5 million over a four-year period would not significantly alter the capital structure of this company, whose capitalization exceeds \$1.6 billion. Alternatively, in light of the magnitude of its baseline capital expenditure program, it seems possible that Ohio Edison might reschedule its other capital expenditures in order to free up financing for some or all of the SO₂ equipment.

Ohio Power's financing difficulties appear to be the most severe of the Ohio utilities. While the amount of SO₂-related financing to other financing requirements is almost the same as for Cincinnati Gas and Electric and Toledo Edison, Ohio Power's

financial condition is much more constrained. With a Moody's rating of Baa and future financing requirements which should keep the coverage ratio very close to 2.0, Ohio Power's ability to raise additional debt is extremely limited. As in the case of Ohio Edison, however, equity financing could offer a possible solution. American Electric Power, which owns Ohio Power, had a market-to-book ratio of 1.03 in May 1976. Since then the stock price has increased slightly. One cannot guarantee the continuation of that level, but at this point it does appear possible to finance the SO₂ expenditures in whole or in part through common equity.

A recent development which is not reflected in this analysis is Ohio Power's recent announcement of the pending closure of the two power plants. If that happens and the cost of installing SO₂ equipment at those two plants is excluded, the company's SO₂ expenditures will decrease from \$68 million to about \$5 million. Even in its current financial condition, Ohio Power can reasonably be expected to be able to finance that reduced level of expenditures.

It should also be noted that these two companies may elect to adopt less capital intensive control strategies than assumed in this study. Greater reliance on a low sulfur coal strategy would help alleviate financing problems but probably only at the expense of higher electricity charges to consumers.

E. Energy Impacts

The energy impacts on the utility sector of the proposed and final regulations result directly from the choice of control strategy.

1. Proposed Regulations

Under these regulations, over 50 percent of utility capacity is expected to achieve compliance by switching to a lower sulfur coal. The majority of this capacity is expected to obtain lower sulfur coal from Ohio, some of which is washed coal. Northern Appalachian and Midwestern production is expected to decline, while Ohio, Western and Central Appalachian production is expected to increase. The most significant shift in production occurs in Ohio where a large amount of high sulfur coal is expected to be replaced by medium sulfur coal, with an overall increase in coal production in Ohio of two million tons. This increase is somewhat understated in that it does not include coal lost in the coal washing processes.

The overall increase in coal demand shown in Table V-5 is primarily a result of energy penalties resulting from use of pollution control equipment. The net energy penalty is estimated to be a 3.9 percent increase in energy requirements. In addition to this energy penalty, coal production increases as a result of greater use of western coal which has a lower Btu content than eastern coal.

2. Final Regulations

These generally less stringent regulations result in only one quarter of the utility capacity switching to lower sulfur coal. Because of this fact, the effects on current patterns of coal production are less pronounced under the proposed regulations. As shown in Table V-5 there is relatively little change in coal production patterns, with the major changes being a decline in Northern Appalachian coal production of 1.4 million tons and an increase in Western production of over 2 million tons. Ohio and Central Appalachian production are expected to increase slightly. The relatively slight changes in the production patterns resulting from the final regulations are because much of the shift to lower sulfur coal occurs in Ohio where very high sulfur coal (5-7 percent) is replaced by coal still in the high sulfur range at 3-4 percent.

The overall energy penalty under the final regulations is estimated at 1.5 percent. This is lower than the proposed regulation penalty because of less use of pollution control equipment. The increased use of western coal is also responsible for a slight increase in the total coal production levels.

The changes in coal production patterns by region is summarized in Table V-6.

TABLE V-5
Coal Consumption at Ohio Powerplants
(10⁶ tons)^{c/}

	Low Sulfur (<u><1.0%</u>)	Medium Sulfur (<u>1.0-3.0%</u>)	High Sulfur (<u>> 3.0%</u>)	<u>Total</u>
<u>Current Consumption</u>				
Ohio	a/	5.7	25.7	31.4
Northern Appalachia	.1	3.9	4.0	7.9 ^{b/}
Central Appalachia	2.5	4.5	.4	7.4
Western	1.6	a/	0	1.6
Other	<u>0</u>	<u>.9</u>	<u>1.3</u>	<u>2.2</u>
Total	4.2	15.0	31.4	50.5 ^{b/}
<u>Proposed Regulations</u>				
Ohio	a/	17.0	16.4	33.4
Northern Appalachia	a/	2.6	1.7	4.4 ^{b/}
Central Appalachia	1.1	8.0	.1	9.2
Western	4.1	0	0	4.1
Other	<u>0</u>	<u>.8</u>	<u>1.0</u>	<u>1.8</u>
Total	5.2	28.4	19.2	52.9 ^{b/}
<u>Final Regulations</u>				
Ohio	a/	6.1	25.5	31.6
Northern Appalachia	.1	3.1	3.3	6.5
Central Appalachia	2.1	5.1	.4	7.6
Western	3.7	a/	0	3.7
Other	<u>0</u>	<u>.9</u>	<u>1.4</u>	<u>2.2^{b/}</u>
Total	5.9	15.2	30.6	51.7 ^{b/}

a/ Less than .05 unit.

b/ Does not total due to independent rounding.

c/ Includes derated capacity replacement and new powerplants.

Table V-6

UTILITY COAL CONSUMPTION

<u>REGION</u>	<u>EXISTING</u>	<u>PROPOSED REGULATION</u>	<u>FINAL REGULATION</u>
Ohio	31.4	33.4	31.6
Northern Appalachia	7.9	4.4	6.5
Central Appalachia	7.4	9.2	7.6
Western	1.6	4.1	3.7
Other	<u>2.2</u>	<u>1.8</u>	<u>2.2</u>
<u>TOTAL</u>	<u>50.5</u>	<u>52.9</u>	<u>51.7</u> ^{a/}

a/ does not total due to independent rounding.

SECTION VI

INDUSTRY

A. Introduction

The evaluation of the economic impact of the sulfur oxide regulations in Ohio focused on 302 manufacturing plants and institutional establishments (universities, hospitals, etc.). Excluded from coverage were plants which burned natural gas exclusively as well as those for which current sulfur emissions were negligible. Roughly three-quarters of the plants reviewed in this study were boilers while the remainder were general process fuel burners such as cement plants, chemical processes such as sulfuric acid and fuel gas burning industrial processes (oil refineries and steel plants).

This section presents the summary results of an evaluation of compliance status, costs, economic and energy impacts of the proposed and final sulfur oxide regulations on these industrial establishments.

B. Costs and Compliance

1. Compliance Status

a. Proposed Regulations

Of the 302 plants covered in this study 128 appear to be out of compliance with the proposed regulations. As might be expected, one-half of these plants are in five energy intensive industry sectors: primary metals, chemicals, petroleum refineries, rubber and paper. Two-thirds of the non-complying plants are located in Ohio's thirteen urban counties, primarily in Cuyahoga, Franklin, Stark and Summit counties.

b. Final Regulations

Under the revised regulations 113 plants appear to be out

of compliance. 83 percent of the non-complying plants are located in the urban counties, reflecting the increased stringency of regulations applying to boilers in urban areas and the relaxation of regulations in rural counties in comparison to the proposed regulations.

2. Annual Costs^{1/}

Table VI-1 presents the annual costs of compliance under both proposed and final regulations. The cost drops from nearly \$50 million to \$41 million under the final regulations. The distribution of cost impacts among industries, shown in Table VI-2, indicates that petroleum refining, primary metals, chemicals and institutions account for over 80 percent of the cost impacts under both sets of regulations. The most significant difference between the proposed and final regulations can be seen in Table VI-3 which shows cost impacts by type of industrial installation. The share of annual costs borne by boilers increases from 40 percent under the proposed regulations to 70 percent under the final regulations reflecting the increased stringency of emission limits applying to steam generating facilities in urban areas under the final regulation.

3. Capital Costs

Table VI-1 shows that capital costs fall from \$67 million (in 1975 prices) under the proposed regulations to \$52 million under the final regulations. Under the proposed regulations, industry specific process regulations applicable to steel mills, petroleum refineries and sulfuric acid plants account for all capital costs since low sulfur coal is projected to be the exclusive control strategy adopted by boiler and fuel combustion process installations.

1/ includes annualized capital charges plus fuel and other operating costs, and a rate of return on equity.

TAELE VI-1

INDUSTRIAL
COSTS OF SULFUR OXIDE REGULATIONS

(Millions of 1975 Dollars)

<u>Alternatives</u>	<u>Capital Costs</u>	<u>Annual Costs</u>
(1) Proposed	66.6	49.5
(2) Final	<u>51.9</u>	<u>41.2</u>
<u>Cost Reduction</u>	<u>14.7</u>	<u>8.3</u>

TABLE VI-2

DISTRIBUTION OF ESTIMATED ANNUAL COSTS
OF INDUSTRIAL COMPLIANCE

<u>Industrial Category</u>	Percent of Total Annual Cost	
	<u>Proposed Regulation</u>	<u>Final Regulation</u>
Chemicals	28.3%	30.2%
Primary Metals	34.5	32.9
Petroleum Refining	7.8	7.3
Stone, Clay and Glass	7.4	0.0
Institutions	<u>6.0</u>	<u>10.1</u>
<u>Subtotal</u>	<u>84.1%</u>	<u>80.5%</u>
Other Sectors	15.9%	19.5%

TABLE VI-3

ANNUAL COSTS OF PROPOSED AND FINAL
REGULATIONS BY TYPE OF INDUSTRIAL INSTALLATION
(% of Annual Costs)

<u>Type of Installation</u>	<u>Proposed Regulation</u>	<u>% of Total Annual Cost</u>	<u>Final Regulation</u>	<u>% of Total Annual Cost</u>
Boilers	46.2		67.8	
General Processes	7.4		.7	
Chemical Processes	10.3		6.5	
Fuel Gas Burning Processes	<u>36.2</u>		<u>25.1</u>	
<u>TOTAL</u>	<u>100.0</u>		<u>100.0</u>	

Under the final regulations, capital costs decline due to less stringent regulations on industry specific processes. In addition, boilers and general process sources account for approximately 25 percent of the capital costs.

C. Industry Impacts

1. Prices

Production and related employment impacts can result from the costs of complying with sulfur oxide regulations if the resultant product price increases at affected plants lead to plant shutdowns and production curtailment. The average price increase due to control costs for all industry or even by industrial categories is estimated to be negligible (far less than 1 percent) since many plants are in compliance and incur no cost or price increases at all. Consequently, the analysis focused on the distribution of price impacts within industry among the affected plants.

a. Proposed Regulations

Most of the plants out of compliance with the proposed regulation are estimated to experience price increases below 1 percent. A substantial price increase was estimated for 20 plants representing 12 plants and 8 institutions. (Shown in Table VI-4.)

Although the magnitude of these price impacts estimated to occur under the proposed regulations may lead to substantial output and employment effects, time constraints did not permit a followup analysis of these impacts.

b. Final Regulations

Nearly all of the plants that are out of compliance under the final regulation experience price increases of less than 1 percent.

TABLE VI-4

PRICE IMPACTS FOR INDUSTRIAL INSTALLATIONS^{1/}
PROPOSED REGULATION AND FINAL REGULATION

<u>INDUSTRY</u>	<u>PROPOSED PERCENT INCREASE</u>	<u>FINAL PERCENT INCREASE</u>
Sulfuric Acid	5-23	3-20
Cement	1-5	---
Rubber Products	1-10	---
Institutions	1-12	> 5

1/ Assumes 100% of the cost increases are passed on to consumers.

The only substantial impacts were those experienced by four sulfuric acid plants (averaging 10 percent) and by two government installations where fuel cost increases would cause current budget requirements to rise by more than 5 percent, as summarized in Table VI-4.

Industrial sectors for which price increases below 1 percent were incurred are not expected to experience measurable production or employment affects.

2. Sulfuric Acid Industry Impact Analysis

The capital costs of installing pollution abatement systems on sulfuric acid plants in Ohio exceeded \$7 million and the resultant price increases for the affected plants ranged from 1-20 percent of an average price of \$33 per ton.

However, it appears unlikely that the sulfuric acid industry in Ohio will be seriously impacted by the final EPA regulations.

The four affected Ohio sulfuric acid plants employ approximately 420 workers, averaging 105 workers per plant. In total numbers, any employment impact would affect only a small number of employees and less than 1 percent of all employees in the state.

Transportation costs for sulfuric acid tend to be very high in relation to product price, leading to a marketing structure where consumers are typically within 200 miles of the supplying plant. The most likely alternative supplies of sulfuric acid which could capture Ohio markets as a consequence of abatement costs incurred by Ohio producers are plants in neighboring states. Transport costs from these states to Ohio markets range from \$7-26 per ton of acid. If the industry is competitive within Ohio, these transport cost differentials appear to overshadow the \$1-6 per ton price increases projected to occur in order to comply with Ohio emission regulations. Furthermore, neighboring states are also subject to a similar range of sulfur emission

limits and associated control costs which would further serve to protect the markets of sulfuric acid plants in Ohio. One possible source of competition is Canadian imports, although precise effects of such impacts could not be evaluated within the time frame of this study.

Another potential threat to the markets of Ohio sulfuric acid industry might be for the consumers themselves to build sulfur processing facilities. This threat, however, seems highly unlikely due to the high capital costs of these plants (in relation to sales) and the fact that such plants would have to comply with Federal New Source Performance Standards which are more stringent than the final regulations on existing Ohio plants.

Although capital requirements are estimated to be substantial for all the sulfuric acid plants needing control, it appears that these capital costs will have a relatively small impact. Under the proposed regulations 4 companies (owning five plants) incurred capital costs. Under the final regulations, three of the same companies (owning four plants) incurred capital costs. In each case, all but one company were large, diversified corporations for which the capital costs of pollution abatement were far less than 1 percent of total corporate capital expenditures.

For one firm, a single plant corporation, incremental capital costs of compliance probably constitutes a significant percentage increase in investment expenditures.^{1/} However, this firm has a partially captive market and is already nearing completion of plans to install control equipment that would meet the final USEPA regulations. It appears that no significant impact on investment demand will be felt by sulfuric acid producers as a result of the USEPA regulations.

1/ Corporate financial records for this firm could not be obtained in the time available for this study.

Finally, the most significant factor is that the sulfuric acid plants already appear to have undertaken the necessary compliance steps and have done so in response not to the USEPA regulations, but to the existing state regulation. Therefore, no significant additional impacts of the USEPA regulations on the sulfuric acid industry are expected.

Apparently only one sulfuric acid plant has delayed installation of control systems; the plant has threatened shutdown as of September 1, 1976 unless litigation by the state, based on the plant's violation of the state regulation, is dropped. If that plant does shutdown, its markets could presumably be captured by other Ohio plants, further reducing the likelihood of any adverse impacts on the other sulfuric acid producers in Ohio.

3. Financial Impacts on Other Industries

a. Proposed Regulations

Analysis of sulfur oxide control equipment needs by industry suggested that plants owned by 16 corporations had capital requirements that appeared to be substantial in relation to normal investment demands. These were with a few exceptions, large integrated companies in the steel, chemical and petroleum refining industries. A more refined comparison of the ratio of added financial requirements to average investment levels over the 1973-75 period^{1/} indicated that nine firms would probably experience an increase in total corporate investment as high as 1 percent. These are steel, rubber and sulfuric acid. All others experience impacts of less than 1 percent.

b. Final Regulations

13 plants owned by 9 firms appeared to experience substantial capital investments as a consequence of sulfur emission limits.

1/ For most industries, the use of these recession years as a basis for calculating "normal" investment levels will tend to overstate the financial impact.

However, incremental capital requirements due to the regulations are expected to account for increases in total corporate investment greater than 1 percent for only three firms. One firm is a sulfuric acid plant which was discussed above. All other firms are steel producers. For all other corporations reviewed, added capital requirements added less than three tenths of 1 percent of recent average levels of investment demand.

4. Steel Industry Impact Analysis

Six steel plants appeared to incur capital costs under the final regulations. The capital costs of installing controls on the impacted steel plants in Ohio will total \$9.8 million. These six plants are owned by four companies. However, when the increase in capital expenditures was examined at the corporate level, the analysis indicated that only two companies (including three plants) would be required to increase annual capital expenditures by more than 1 percent. To evaluate the impact of the final regulations on these two companies, industry, company and plant specific factors were considered. Two plants are expected to comply without difficulty while the third has already experienced difficulty meeting environmental requirements.

Prospects for growth and profitability in the steel industry have improved since the early 1970's when depressed profit margins and a rising volume of impacts threatened the viability of certain sectors of the industry. The ability of the industry to raise or internally generate the necessary capital to comply with SO₂ regulations will be a function of future earnings prospects.

In general, the fortunes of steel are tied to those of the general economy. Increased manufacturing activity and higher demand for consumer durables and capital goods will improve the profitability of steel companies. An economic downturn on the other hand could reduce capacity utilization and cause severe profit declines because of the high fixed costs involved in the steel manufacturing process.

Both of the steel companies affected are among the top ten steel producers in the nation. Together, their capital expenditures in 1975 exceeded \$340 million. Projections through 1977 show that the companies will more than double their capital expenditure rates of 1974. These investments will be financed by a combination of long term debt and internally generated funds that will allow the companies to maintain historical debt equity ratios. Both have interest coverage ratios greater than 2.5 and are expected to maintain adequate coverage ratios.

Because capital expenditures are projected to increase rapidly, the impact of the proposed controls on a percentage of 1977 capital expenditures will be quite low. Assuming that the expenditures are spread over three years, in neither case will they amount to greater than 1 percent of projected 1977 capital expenditures. These investments would not significantly affect the companies' capital structures. Even if all the funds were borrowed, they would amount to less than .5 percent of outstanding (on balance sheet) long term debt.

The decision to invest additional capital in pollution control equipment, however, will depend on plant specific factors including profitability, age, replacement value and other pollution control expenditures required. One of the plants is in the Mahoning River Valley and since 1970 the company has invested over \$50 million in the facility.^{1/} The additional requirements for air and water pollution controls, however, could be over \$100 million. The willingness of the company to make the requisite expenditures will depend upon their estimate of the future competitiveness of the plant.

The other steel company with two impacted plants has a strong capital structure. In addition the impacted plants are relatively new and there are no obvious obstacles to preclude the necessary investments.

1/ Booz-Allen and Hamilton, Economic Impact of Pollution Control Regulations on Steel Plants in the Mahoning River Valley, USEPA, 1976.

D. Energy Impacts - Industrial

Energy impacts in the industrial sector may be significant under both regulatory options. The main impact in both cases is a shift in current consumption patterns due to increased demand for low sulfur coal. This can be seen in Table VI-5. Energy penalties are insignificant because of limited use of FGD under either regulation. Some fuel switching from coal to oil occurs under the final regulations.

1. Proposed Regulations

The main impact of the proposed regulations is to create a major shift in the consumption patterns. The demand for high sulfur coal drops by 80 percent, and consumption of medium sulfur coal increases by approximately 50 percent. Low sulfur coal demand shows moderate increases.

Energy penalties are insignificant. A very small number of plants, and a very small percentage of the energy consumption is expected to use FGD, and no plants are expected to switch to oil. Low sulfur coal derates are not a factor because use of western coal is not considered a feasible alternative for industry.

Production effects are significant because of the large shift to low sulfur coal. Where the existing consumption is approximately divided between Ohio and Central Appalachian production, the expected consumption under the proposed regulations

Table VI-5

Coal Supply for Ohio Industrial Boilers
(10³ ton/yr)

<u>Supply Area</u>	<u>Low Sulfur</u> <u>(< 1.2%)</u>	<u>Medium Sulfur</u> <u>(1.2-3.0%)</u>	<u>High Sulfur</u> <u>(> 3%)</u>	<u>Total</u>
Current Consumption				
Ohio	0	1511	2840	4351
Northern Appalachia	0	424	0	424
Central Appalachia	3207	1134	0	4341
Total	3207	3069	2840	9116
Proposed Regulations				
Ohio	0	3262	545	3807
Northern Appalachia	0	145	0	145
Central Appalachia	3919	1240	0	5159
Total	3919	4647	545	9111
Final Regulations				
Ohio	0	1550	1713	3263
Northern Appalachia	53	173	0	226
Central Appalachia	5204	411	0	5615
Total	5257	2134	1713	9104

shifts to 57 percent central Appalachian coal. Ohio industrial coal consumption is expected to decline by approximately one-half million tons.

2. Final Regulations

The final regulations are expected to produce major changes in industrial coal consumption patterns. These regulations definitely imply a greater use of low sulfur coal at the expense of both medium and high sulfur coal. The use of high sulfur coal is less restricted than under the proposed regulations, however, medium sulfur coal use is decreased by almost a million tons from existing consumption, and low sulfur coal use is increased by two million tons.

Energy penalties are insignificant. Only one facility is expected to use FGD, and that facility is not a boiler but rather a general process coal user. Under the final regulations only one facility is projected to shift from coal to oil.

Coal production effects are major. Ohio production is expected to decrease by over one million tons, which is compensated by increased demand for Central Appalachian coal. Central Appalachian coal is expected to fill 62 percent of Ohio industrial coal needs. Overall, the total demand for coal declines slightly due to fuel switching.

SECTION VII

BENEFITS OF AIR QUALITY STANDARDS FOR SULFUR OXIDES

This section presents a brief discussion of the positive effects, or benefits, expected to occur from the promulgation of sulfur oxide emission standards for the State of Ohio.

"Benefits" result from improvement in conditions due to attaining these regulations or reduction of the damages that would occur without them. Such improvements include effects on health, vegetation and crops, materials, animals, recreation, and aesthetics.

Such improvements also include secondary effects such as increased demand for capital and employment in such areas as epidemiologic and environmental research, engineering, and production and maintenance of control systems. There is insufficient data to indicate the increase in number of jobs or earnings that would result nor is it known where such activities would be located.

The numerous difficulties associated with attaching dollar values to qualitative human health and welfare improvements would limit the usefulness of economic analysis of benefits. In addition, certain prerequisite scientific-technical data is necessary in order to provide meaningful economic analyses of benefits. There are yet a number of unresolved questions regarding health and welfare improvements associated with sulfur dioxide control.

The major focus of benefits for Ohio are those of improved health and welfare, and increased demand for pollution control equipment, generating more jobs and higher levels of investment.

APPENDIX A

INFLATION IMPACT STUDY DOCUMENTATION

This appendix identifies the documents prepared to support the Inflation Impact Analysis of the sulfur oxide regulations prepared by the U.S. Environmental Protection Agency (EPA) for the state of Ohio.

Figure 1 identifies the supporting documents. Document #2 provides an overview of the study methodology, illustrates the depth of analysis contained in the study, and provides a summary of the content of each support document.

Impact Studies

Documents #3 and 4 are economic impact analyses of the utility and industrial sectors in Ohio. These reports address impacts on prices, output, employment and financial viability. Document #5 summarizes the energy impacts of the regulation in terms of the level of energy demand, shifts from coal to oil likely to occur as a result of compliance with the regulations as well as shifts in coal production patterns. In particular, this report focuses on whether coal production in Ohio, which is generally high in sulfur content, will be adversely impacted.

Cost Minimization

Documents #6 and 7 present the methodology for estimating costs of compliance and the choice of pollution control strategies. For both utility and industry, these supporting documents outline the cost minimizing strategies which provide the basis for the economic and energy impacts discussed in documents #3 - 5.

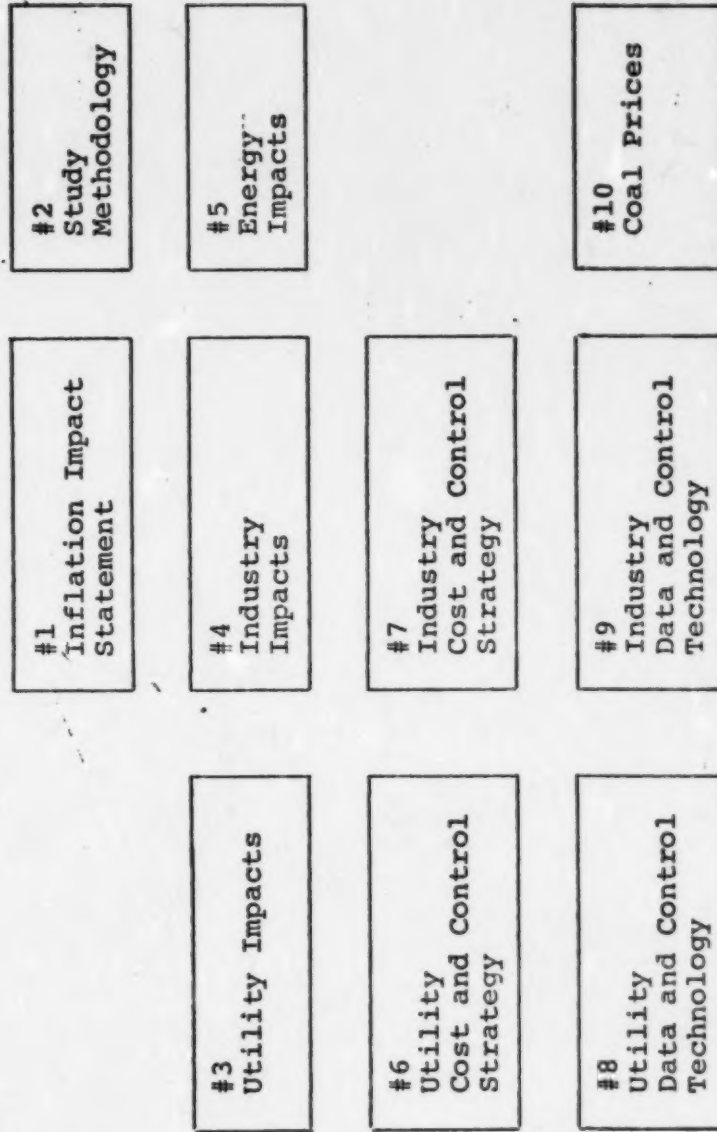
Figure 1

INFLATION IMPACT STATEMENTS SUPPORTING DOCUMENTS

IMPACT STUDIES

CHOICE OF CONTROL
STRATEGIES

COST INPUTS



Cost Inputs

These final documents contain the basic data inputs to the study. Document #8 describes the pollution control technology options, their costs plus basic plant specific parameters which influence costs such as fuel consumption and boiler firing rates. Document #9 contains similar data on the industrial sector. Document #10 presents the derivation of coal prices employed in this study and used in both the industry and utility sector analysis. The focus is on the price premium of low versus high sulfur coal.

Contributions

The study was carried out under the overall direction of Mr. Tom Schraeder of the Office of Planning and Evaluation and Mr. Alan Basala of the Office of Air Quality Planning and Standards. These reports were based on the work of four EPA contractors whose contributions are outlined below.

Energy and Environmental Analysis, Inc.

- development of overall study methodology and preparation of document #2
 - IIS (document #1)
 - Industry Economic Impact Study (document #4)
 - Energy Impact Study (document #5)
 - Utility Cost Minimization (document #6)
 - Coal Prices (document #10)
 - Industry Cost Minimization (document #7)
- Temple, Barker and Sloane, Inc.
- Utility Price and Financial Impact Analysis (document #3)

PEDCO Environmental Specialists, Inc.

- utility costs for pollution control equipment and coal conversion equipment
- basic plant data parameters (document #8)

Battelle Columbus Laboratories

- cost algorithms for pollution control equipment for industry
- basic data on industrial boilers in Ohio (document #9)